We claim:

1. An engineered catalyst comprising:
a support material having through-porosity;
a layer comprising carbon nanotubes on the support material; and
a surface-exposed catalyst composition.

2. The catalyst of claim 1 wherein the support material has an average pore size, as measured by microscopy, of at least 1 micrometer (μm).

3. The catalyst of claim 1 wherein the support material has an average pore size, as measured by mercury porisimetry and nitrogen adsorption, of 0.3 to 200 μm.

4. A method of conducting a catalyzed chemical reaction, comprising:
passing at least one reactant into a catalyst of claim 2;
reacting the at least one reactant to form a product.

5. A catalyst comprising:
a support;
nanotubes disposed over said support;
an oxide disposed over the nanotubes; and
a catalyst composition disposed over the oxide.

6. The catalyst of claim 5 wherein the oxide layer comprises a mesoporous layer.

7. A Fischer-Tropsch process comprising:
passing a gaseous composition over the engineered catalyst of claim 1,
wherein the gaseous composition comprises CO and hydrogen; and
forming a hydrocarbon.

8. The process of claim 7 wherein the catalyst composition comprises Co.

9. A method of converting a chemical reactant, comprising:
passing at least one reactant into a reaction chamber;

wherein the catalyst of claim 1 is disposed within the reaction chamber; and

reacting the at least one reactant in the a reaction chamber to produce at least one product.

10. The method of claim 9 wherein the reaction chamber has an interior with a cross-sectional area and the engineered catalyst occupies at least 80% of said cross-sectional area.

11. The method of claim 10 wherein the reaction chamber is a microchannel and the engineered catalyst comprises a monolith.

12. A microreactor comprising an array of microchannels wherein each of the microchannels in said array comprises an engineered catalyst of claim 1.

13. The microreactor of claim 12 wherein the array of microchannels is in thermal contact with at least one microchannel heat exchanger.

14. The catalyst of claim 1, wherein the engineered catalyst has a volume of at least 5 mm^3.

15. The catalyst of claim 1 containing 0.1 to 20 weight % carbon.

16. The catalyst of claim 1 which, when tested at 265 °C, at 16 atm, a H_2/CO ratio of 2, and a 250 msec contact time, exhibits: a CO conversion of at least 25%, a methane selectivity of less than 30%; and a specific activity (defined as mmol CO converted per gram of total metal (which does not include metal in oxide support) per hour) of at least 1500.

17. The process of claim 7 having a CO conversion of at least 25%, a methane selectivity of less than 30%; and a specific activity (defined as mmol CO converted per gram of total metal (which does not include metal in oxide support) per hour) of at least 2000.

18. The process of claim 7 having a CO conversion of at least 25%, a methane selectivity of less than 30%; and a specific activity (defined as mmol CO converted per gram of total metal (which does not include metal in oxide support) per hour) of 1800 to about 2400.

19. A method of forming an engineered catalyst comprising:
providing a large pore support having through porosity;
forming carbon nanotubes over the large pore support; and
depositing a catalyst composition precursor over the carbon nanotubes.

20. A method of converting a chemical reactant, comprising:
passing at least one reactant into a reaction chamber;
wherein the catalyst of claim 5 is disposed within the reaction chamber; and
reacting the at least one reactant in the a reaction chamber to produce at least one product.

21. The method of claim 20 wherein the at least one reactant is in liquid solution.